Model 7XX8 Digital Brushless Driver

FEATURES

- **DSP controlled torque, velocity, or position mode using encoder feedback from the motor**
- **Windows 98 software**
- **Command sources:**

  Analog +/-10V inputs
  Digital PLS/DIR, CW/CCW
  Digital Presets
  Data RS-232, RS-485

- **Select up to 16 preset modes using a PLC or Logic Hi/Lo line**
- **Programmable S-curve and trapezoidal motion profiles**
- **RS-232 or RS-485 digital interface used to store all settings in internal FLASH memory for selecting preset modes**
- **Separate motor signal and control signal Sub-D type connectors for simpler cabling**
- **Terminals for DC Buss connect to external regenerative energy dissipator**
- **Input for motor temperature sensor protects motor**
- ***No Transformer Required!* AC Version operates directly from AC mains, DC Version operates from rectified line, with full optical isolation between signal and power stages.**
  32~132VAC (7228)
  32~264VAC (7428)
- **Fault protections:**
  Short-circuits from output to output, output to gnd
  Over/under voltage
  Over temperature

APPLICATIONS

- **Linear Brushless Motors**
- **Automated assembly machinery**
- **Packaging Equipment**

MODEL	VOLTAGE	I-PEAK	I-CONT
7228AC	32~132VAC	20	10
7428AC	32~264VAC	20	10
7228DC	45~186VDC	20	10
7428DC	45~373VDC	20	10

PRODUCT DESCRIPTION

The 7XX8 series are DSP (Digital Signal Processor) controlled PWM servo amplifiers from Copley Controls Corp. for control of AC brushless motors that require sinusoidal commutation. 7XX8AC Models operate directly from the AC mains while 7XX8DC Models operate form directly rectified line. All models have full isolation between signal and power stages. No power transformers are required.

All models take industry standard ±10V analog control signals for torque or velocity control. In addition, stepper-motor command pulses in CW/CCW, or PLS/DIR format, can be used for position control. External devices, such as sensors or PLC connections, can initiate presets. Presets can include a profiled move to a specific position, a change in tuning parameters, or a complete change in operating mode. Through the 4 preset logic lines up to 16 distinct presets can be initiated.

Each driver will contain configuration information stored in nonvolatile Flash Memory on the driver. Through the RS-232 port a single driver can be configured for an unlimited number of axis in a system. The Copley Motion Explorer software, a windows 95/98 visual basic interface, can be used to tune, configure, and analyze the drive. The configuration data can be uploaded and saved to disk for replicated usage. Consequently, the modularity of the 7XX8 driver provides the user with a single spares inventory that can be configured over all the needs of a system.

Windows 95/98 & NT DLLs (Dynamic Link Libraries) work with virtually all windows programing languages, including Visual C/C++, Visual Basic, and others.

A growing database of motor models and a continuously evolving collection of amplifier operating modes are available as resources for the 7XX8 Driver.

Technical specifications

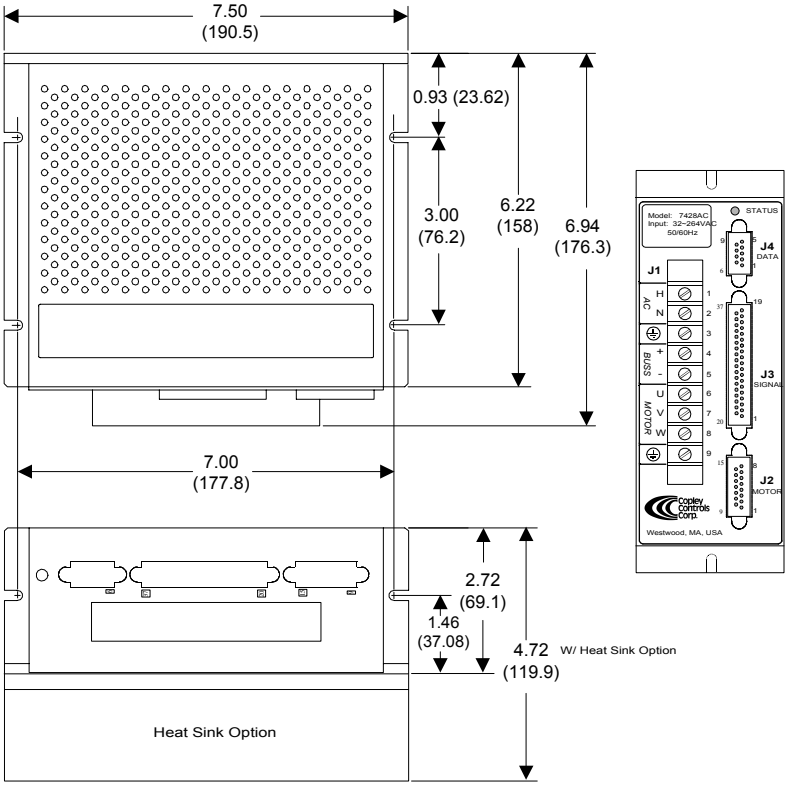
Test conditions: 25°C ambient, Load = 400□H. in series with 1 Ohms.

MODEL	7228AC	7428AC
OUTPUT POWER		
Peak power	20A @ 110V	20A @ 205V
Peak time	1 second at peak power.	
Continuous power	10A @ 130V	10A @ 250V
OUTPUT VOLTAGE		
On-resistance (Ro, ohms)	0.2	0.15
Max PWM Peak Output Voltage	±Vout = (VAC X 1.41 -2)X(0.97) - (Ro)X(Io)	
Maximum effective output voltage at continuous power	130V @ 10A	250V @ 10A
Maximum effective output voltage at peak power	110V @ 20A	205V @ 20A
INPUT POWER		
Mains voltage	32~132VAC, 47~63Hz	32~264VAC, 47~63Hz
Mains current @ continuous output rating	16A	16A
Inrush current on startup	37A max	37A max
External mains fuse rating	20A/125V	20A/250V

MECHANICAL

Weight 3.71 lb (1.69 kg) without optional Heatsink. Add 3.2 lb (1.47 kg) for heatsink.

MECHANICAL OUTLINE
AC MODEL



CONNECTORS

J1: Power & motor	9-position terminal strip
J2: Motor	15-position female Sub-D type. #4-40 standoffs for cable shell lock screws
J3: Signal	37-position female Sub-D. #4-40 standoffs for cable shell lock screws
J4: RS-232/485	9-position female Sub-D. #4-40 standoffs for cable shell lock screws

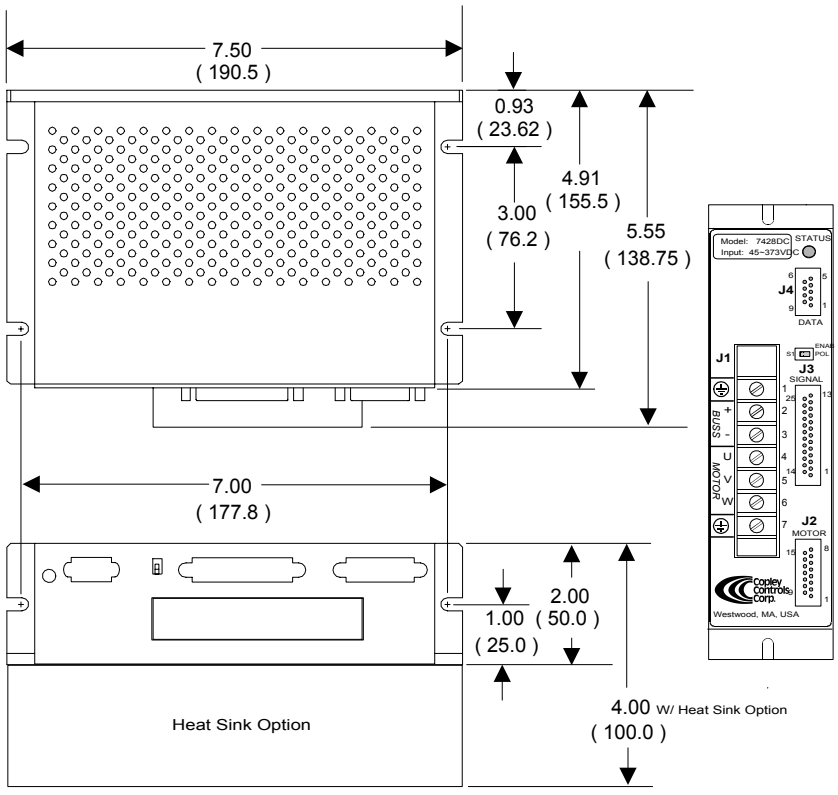
Connector shells are connected to amplifier chassis for grounding/shielding

MODEL	7228DC	7428DC
OUTPUT POWER		
Peak power	20A @ 180V	20A @ 370V
Peak time	1 second at peak power.	
Continuous power	10A @ 180V	10A @ 370V
OUTPUT VOLTAGE		
On-resistance (Ro, ohms)	0.2	0.15
Max PWM Peak Output Voltage	±Vout = (VDC)X(0.97) - (Ro)X(Io)	
INPUT POWER		
Mains voltage	45~186VDC	45~373VDC
Mains current @ continuous output rating	16A	16A
Inrush current on startup	19A max	37A max
External mains fuse rating	20A/125V	20A/250V

MECHANICAL

Weight 2.71 lb (1.23 kg) without optional Heatsink. Add 3.2 lb (1.47 kg) for heatsink.

MECHANICAL OUTLINE
DC MODEL



CONNECTORS

J1: Power & motor	7-position terminal strip
J2: Motor	15-position female Sub-D type. #4-40 standoffs for cable shell lock screws
J3: Signal	37-position female Sub-D. #4-40 standoffs for cable shell lock screws
J4: RS-232/485	9-position female Sub-D. #4-40 standoffs for cable shell lock screws

Connector shells are connected to amplifier chassis for grounding/shielding

LOAD INDUCTANCE

Minimum inductance	400 □H
Maximum inductance	No maximum. Bandwidth varies with inductance and supply.

BANDWIDTH

Small signal	-3dB @ 2kHz with minimum load at nominal supply voltage. Varies with load inductance and PID filter values. 205uS rate.

PWM OUTPUTS

PWM frequency	20kHz
Modulation	Center-weighted, 50% duty cycle at 0V output

REFERENCE INPUTS

Torque or velocity	Analog ±10V	Differential, 94k Ohms between inputs, ±20V maximum
Position	Digital, 2-signal	TTL, Any of three formats: CW / CCW; Pulse/Dir; A & B quadrature pulses.
Preset	Digital, 4 line	TTL, 28V max, Group programmable: 22k Ohms internal pull-up to +5V or pull-down to 0V. The four inputs initiate 16 predefined modes.

ANALOG TACHOMETER INPUT

±120V or ±20V maximum, Jumper selectable. Load 240k Ohms

MOTOR OVERTEMP INPUT

Analog input	5k Ohms internal pull-up to +5V, for thermistor or IC sensor. Thresholds programable.

MOTOR ENCODER

INPUTS	A, B, X	2.2k Ohms internal pull-up to +5V. differential or single ended, 4Meg. Counts/Sec maximum.
BUFFERED OUTPUTS		
	/Enc Buffout A	HCMOS, Differential line driver, Buffered encoder output A
	/Enc Buffout B	HCMOS, Differential line driver, Buffered encoder output B
	/Enc Buffout X	HCMOS, Differential line driver, Buffered encoder output X

HALL INPUTS U, V, W, Single-ended, 10k Ohms internal pull-up to +5V

LOGIC INPUTS

Enable	Enables amplifier within 5ms when active.
Pos Enable	Enables CW rotation.
Neg Enable	Enables CCW rotation.
Reset	Resets latching fault condition, recovers in 1ms.

TTL, 28V max, Group programmable: 22k Ohms internal pull-up to +5V or put-down to 0V. Software programmable active Lo or Hi.

LOGIC OUTPUTS

Status output 1, 2 — Software function programmable.
N-channel MOSFET, 10k Ohms pull-up to +5V, Max. 50V off-voltage,
Max. 250mA sink, 5 Ohms On-resistance. STATUS LED

Bicolor LED changes color and flashes to indicate amplifier operating status

Blinking green	= Ready Amplifier OK, will *run* when enabled
Green	= Normal Amplifier *enabled* AND Amp OK (see above)
Red	= Buss Fault, non-latching Over or under-voltage condition. Amplifier recovers when in normal range
Blinking red	= Latching Fault, Output overcurrent (short circuit), following error, or overtemp condition. Clear with software control, Ground /Reset, or power amp off/on to clear condition

ANALOG MONITOR +/-10V Full scale, 1k Ohms source resistance . Programmable monitor functions.

DC POWER OUTPUTS +5VDC @ 250mA, +12VDC @ 25mA, -12VDC @ 25mA

DATA PORT

RS232 or RS485 jumper selectable. Permits programming parameters from PC. Settings held in flash memory.
RS232 3 wire (TxD, RxD, Gnd).
RS485 5 wire (XMT+, XMT-, RCV+, RCV-, Gnd) differential full duplex.

CONTROLLER GND Floating. Gnd externally. Power stage optically isolated

THERMAL REQUIREMENTS

Storage temperature range -30°C to +85°C
Operating temperature range 0° to 70°C baseplate temperature
Thermal resistance (heatplate to ambient):
No heatsink or fan: 0.92 deg C/W, no heatsink with fan: 0.51 deg C/W
With heatsink: no fan: 0.6 deg C/W; with heatsink and fan: 0.23 deg C/W.

PROTECTION

Output to output short	Latches unit OFF (will reset if /Reset input is wired to ground, or when power is cycled)
Output to ground short	Latches unit OFF (will reset if /Reset input is wired to ground, or when power is cycled)
Overtemperature	Latches unit OFF at 70°C on heatplate (will reset if /Reset input is momentarily grounded, or when power is cycled off/on)
Undervoltage	shutdown at internal DC buss < 45VDC
Overvoltage	shutdown buss > 195VDC (7228) or buss > 390VDC (7428)
Current-limiting	Output current peak, continuous, & peak-time limits programmed via RS232 port

CE CONFORMITY

EN 55011,1992	CISPR 11 (1990) Edition 2/ Amendment 2: Limits and Methods of Measurement of Radio Disturbance Characteristics of Industrial, Scientific, and Medical (ISM) Radio Frequency Equip.
EN 50082-1,1992	Electromagnetic Compatibility Generic Immunity Standard.
EN 61010-1,1993	Safety Requirements for Electrical Equip. for Measurement, Control, and Lab Use.

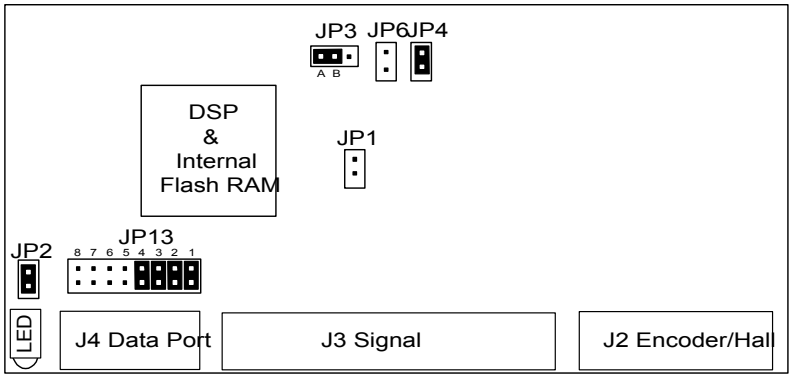
Recommendations

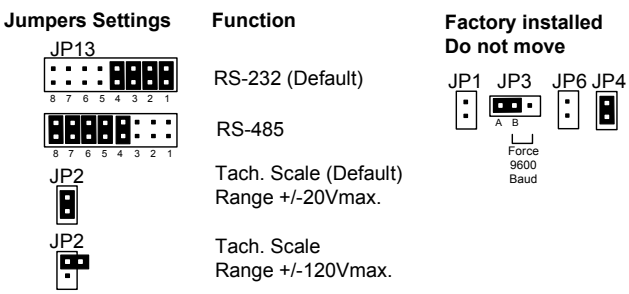
A line filter, such as the Corcom P/N20VDK6, can be installed at least 3 feet from the driver's power entry terminal strip to reduce line noise. This will reduce the systems line noise for compliance with CE emissions limits.

Power supply and motor connections should be made with wire that has a rating to support the amplifiers continuous current. AWG 14 wire will support all amplifiers in this series. Additional recommendations for wire insulation are for a voltage rating of 600V and a maximum temperature of 105°C

Fusing should be time delayed and install on any hot lines coming from the mains. The fusing for the high voltage units should be rated for 250VDC at 25Amps and are to be installed on both hot lines. The fusing for the low voltage units should be rated for 120VDC at 25 Amps and is to be installed on the hot line.

Signal Board Layout





Software installation

To install the Copley software load the CD and run **setup.exe**, after the Copley software is installed the Copley icon will appear on the Windows Program file list. To run the Copley software, double-click on the Copley icon.

Splash screen

When the Copley Motion Explorer software is initiated, the splash screen will appear, See Fig 1. Press the **On-Line** button to work live. If a new motor is being used and no amplifier or motor file is available, then the motor data file can be created off line by pressing **OFF-Line** and using the motor data form.

Copley Controls Corp.
Welcome to
Copley Motion Explorer
Beta Version 1.1.24
Click the buttons below to select the way you want to work:
On-Line
On-Line: connected to an amplifier for programming and setup
Off-Line
Off-Line: for programming amplifiers, motors, or complete axes for downloading later
Copyright (c) 1999 - Copley Controls Corporation
Exit

Fig. 1: Splash screen: Click On-line if the amplfiier is connected.

Communication Form

The Communication form will appear on screen after loading, See Fig 2. Press the **COMM** button for the proper serial port. Press the **Connect** button to connect to the driver. Verify the amplifier data that is indicated on the screen, then press the **Continue** button. If communication is lost then press **Amplifier / Connect to Host** to load the communication form.

Before the Copley software can communicate with the 7XX8 amplifier, the RS-232 or RS-458 port must be connected. If communication is successful then the amplifier found indicator on this form will be illuminated green.

The bar graph indicates that the presets are uploading from the driver to the computer.

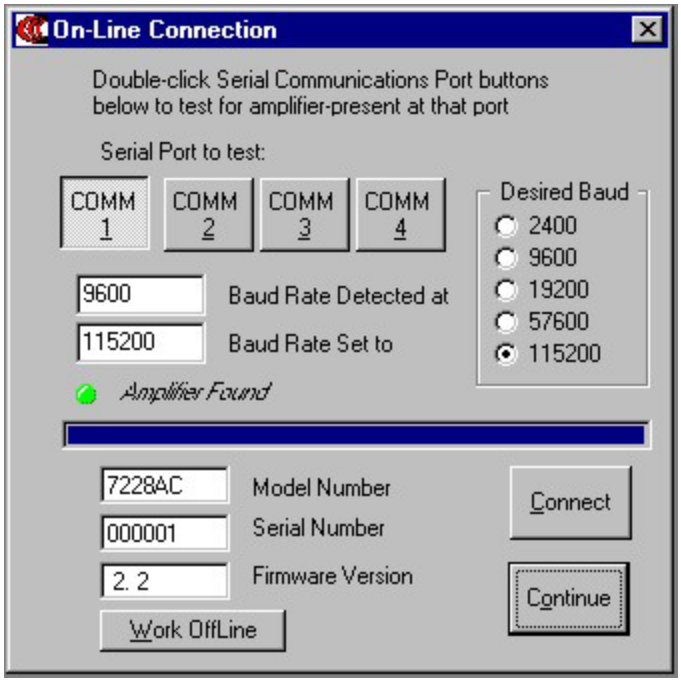


Fig. 2: Communication form: Connect and upload data.

Software and firmware updates

As time progresses into the future, new features and enhancements will be added to the Copley Motion explorer software and DSP firmware. Typically a new release will contain a software and a firmware update. The firmware can be updated through the Copley Motion Explorer by selecting **Tools \ Download firmware** then select the appropriate **cplyXXXX.bin** filename, containing the latest firmware to download. The Download form will display Erasing and then the downloading bargraph. The firmware version can be verified on the communication form after re-establishing communication.

Drive status

The **Amplifier Status Now!** form presents the latest status data retrieved from the driver, See Fig 3. The ***Status Updates*** check-box, located under the communication button, can be checked to continuously retrieve fresh data. The driver's current preset, operating mode, and other critical data are indicated. These settings can be modified by pressing the ***More*** button. When all indicators are illuminated green the drive is enabled and running. If an in indicator is illuminated red then a fault condition has occurred. Press the ***Amp OK*** button to diagnose and correct the fault.

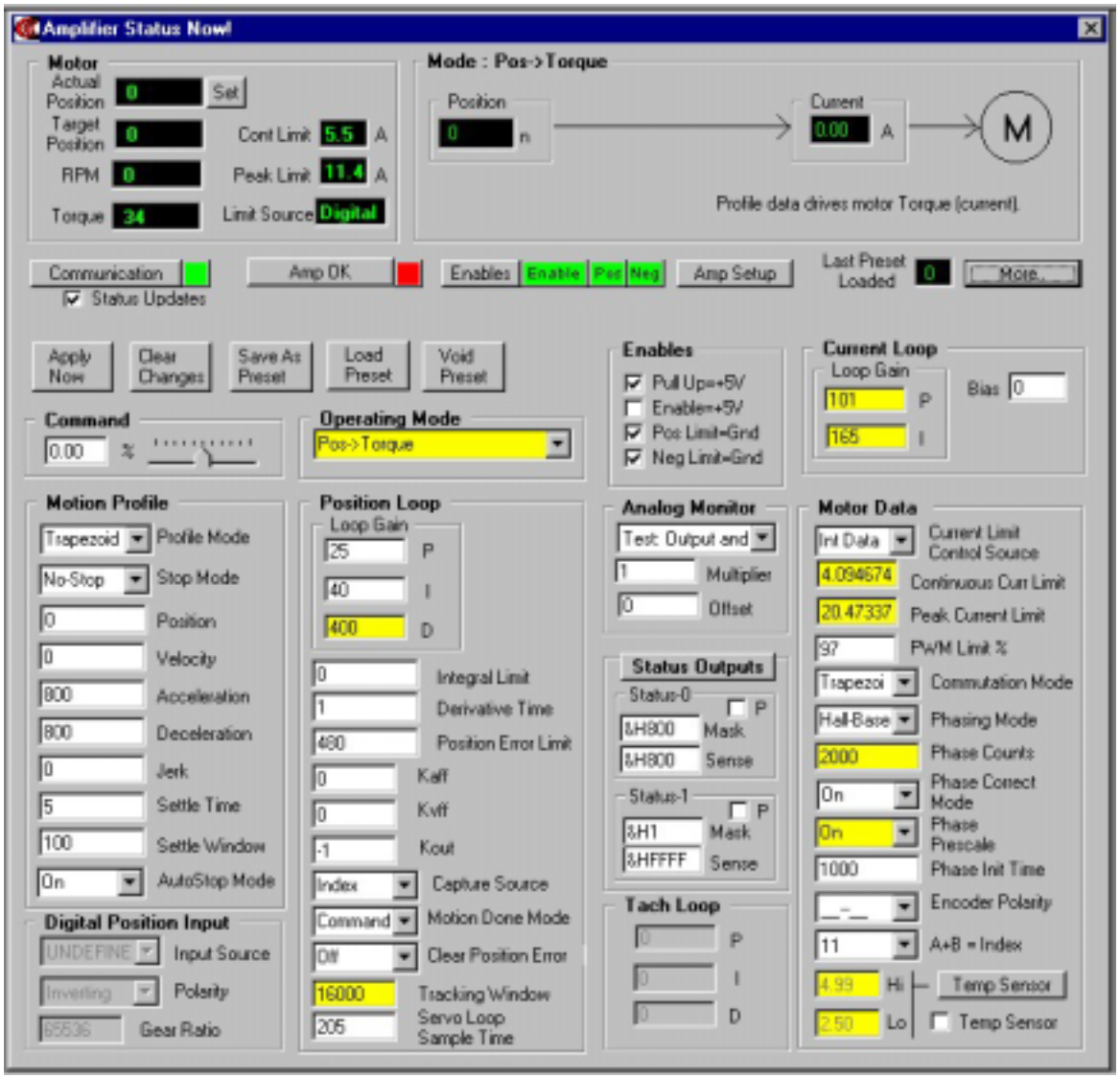


Fig. 3: Status Now form with "More" values for current preset displayed.

Applying changes & saving presets to the amplifier

Changes to the displayed settings are highlighted in **yellow**. These changes can be immediately applied to the amplifier by pressing the **Apply Now** button. The displayed settings can be downloaded to a preset for later execution by pressing the **Save as Preset** button and selecting the desired preset number. Use the **Void Preset** to terminate the values in an amplifier preset. Use the **Load Preset** button to view a preset from the amplifier.

First Move

To make a move the amplifier must be configured for the motor. Typically the demo kit is factory configured for position mode. Refer to the kit application note to verify all preset values. Example: If the application note says "Operating mode is **POS>TORQUE",** then verify that this is true. If values are not correct then make changes as appropriate, apply, and save to the desired preset. Some important values are the P and I values for the current loop tuning, if the current loop gain is too low then poor operation and motor overheating may occur, if too high then oscillations may occur.

Enable the drive

To enable the amplifier, switch the Enable line low with the hardware, or check the ***Enable = +5V*** box, to change the active level of the enable line, See Fig 4. Apply change, but do not save this change to a preset unless necessary. In this default fail safe mode, if the line is cut then the amplifier is disabled. (Enable the drive at this time and verify that the green LED, on the drive, is on.) Refer to the Kit application note for details of factory configured **Presets** and there function.

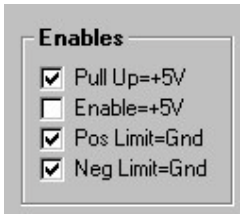


Fig. 4: Enable polarities

Motion Profiles

The ***Profile Mode*** can be trapezoidal, S-curve, velocity, or gearing. If a sinusoidal S-curve profile is chosen then a value ***Jerk*** must be set. The velocity profile is actually a position loop that never gets to the destination. If no value for deceleration is entered than the acceleration value will be used, See Fig 5.

After a move the position count will settle in the settle window, then after the settle time, the settled status will change.

Fig. 5: Motion Profile values

Position loop

The position loop tuning parameters are determined by a math model and are initialized "Soft" and with out loading of the motor. For proper operation with a load, the PID values for the Position Loop may need to be changed, See Fig 6.

A method for tuning:

1. Adjust the integral Limit to 0 or set the integration term "I" to 0.
2. Increase the derivative term "D" for a sufficiently low position error.
3. Increase the proportional gain "P" for a sufficiently stiff position loop.
4. Increase the integration limit and integration term "I" for sufficient holding torque under load.

The position error limit is the number of encoder counts allowed before a position error occurs.

Kout is a multiplier at the end of the digital position loop so, must not be set to zero.

Refer to Users Guide for more details on other position loop values.

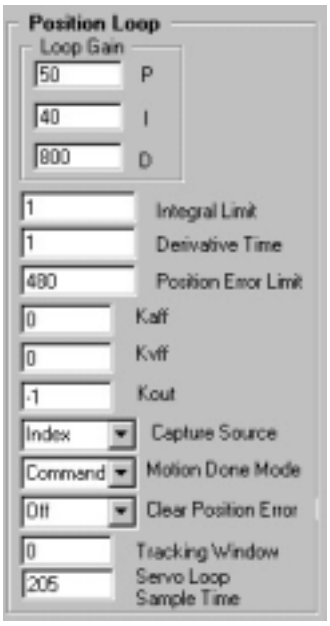


Fig. 6: Position loop values

Trace

The **Trace** form can be used to display measured signals and events. Located on the toolbar at **Tools\Trace**.
Example: The **Position Error** trace can be displayed by selecting the appropriate item in the Trace Var pull-down menu and commanding the motor to a new position, See Fig 7. The trace can be initiated upon updating the driver with new instruction by selecting the **Update** option in the condition options. The trace display can be armed for capturing a trace by pressing the **Arm** button. For continuous arming on a condition check the **Auto Arm** box.

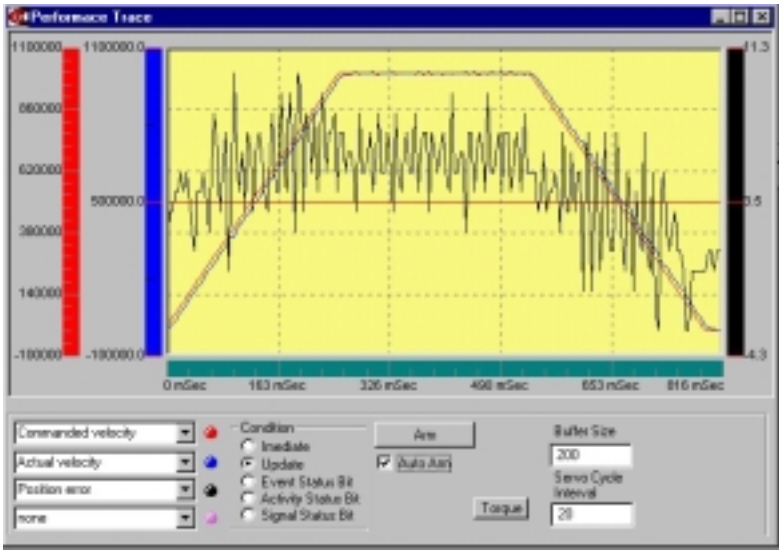


Fig. 7: Trace of trapezoidal motion profile with position error of 10 counts.

Temperature Sensor

If no temperature sensor is used then do not check the Temp Sensor box. If a temperature sensor is used then the operation thresholds can be set using the Temp Sensor form, See Fig 8. Press he temp Sensor button to view the form.

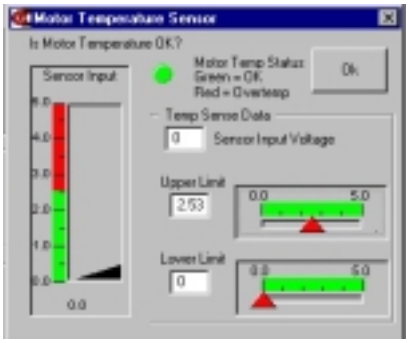


Fig. 8: Temperature sensor input form

Status Output

The status output **Stat-0** and **Stat-1** can be programed to indicate that a fault condition has occurred or a motion profile is active. Press the **Status Output** button located on the Status Now\More form to open the **Status Output** form, See Fig 9. Check the appropriate status box, True/False button, and On Hi/On Low option.

End of Move

The Status line can be used to indicate the end of a move. This is useful for a PLC that is monitoring a line for the end of move indicator, before initiating another preset move.

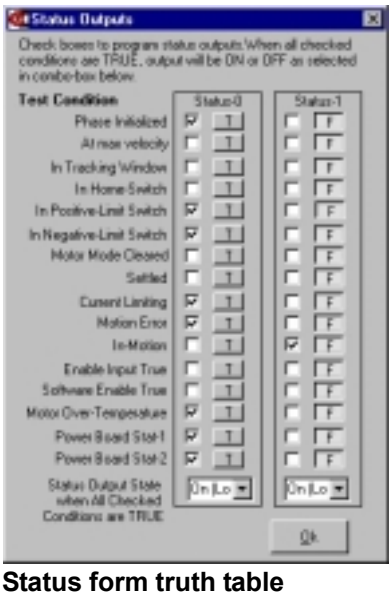


Fig. 9: Status form truth table

Saving an Amplifier Configuration

During initial communication with the amplifier, all the presets are uploaded to the computer. If the amplifier has not been pre-configured then all the presets will be void. If the Copley amplifier has been pre-configured to operate with a particular motor then some or all of the presets will be configured. These presets can be viewed with the Preset Manager. An amplifier configuration can be saved to a **.cca** file, use the **File\Save As** form to save the file with an appropriate name, such as **Demo343GR-001.cca.**

Using a new motor

Downloading an Amplifier Configuration

To open the ***.cca*** file containing a previously configured amplifier data, use the **File\Open** form to locate and open a file. Existing motor and amplifier files are available on disk or through the Internet.

Motor data file

To create a new **.ccm** motor file, use the **Motor \ Motor Data** form to enter the motor's type, feedback, electrical, and mechanical data, See Fig 10A. When all the data has been entered press the **Save** button to save the file with an appropriate name.ccm. After the motor data form has been filled press the **Calculate Amp Data** button. This will generate initial tuning parameters form a mathematical model for initial testing.

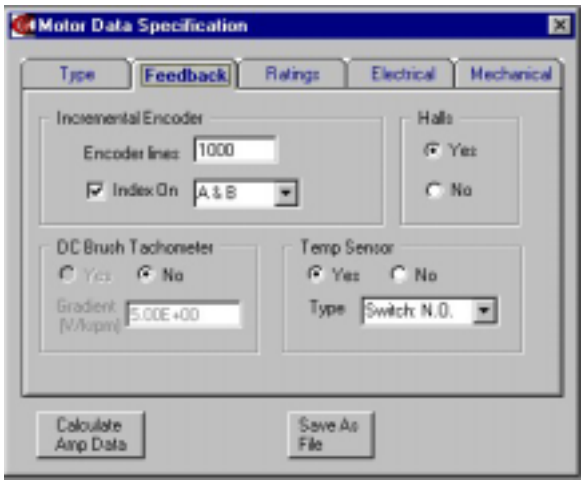


Fig. 10A: Motor data used for initial tuning calculations.

Press the **Apply to Amp** button to apply the calculated initial tuning values to the Status Now form.

Motor Data

After the motor data is loaded, whether from an amplifier file or from a model calculation, verify that the values are correct, See Fig 11A.

The current limit source can be external, where a voltage or resistance is used to set the peak current limit, or internal where the continuous current limit and peak current limit values are used.

The average voltage can be limited to the motor by setting the PWM limit %.

An important value to get correct is the Phase counts, the number of encoder counts per electrical cycle.

If the motor has Halls then Trapezoidal or Sinusoidal commutation, and Hall-based or Algorithmic phasing can be used. If no Halls are present, then use algorithmic phasing mode with Phase correction mode ON, Phase initialization time set, and sinusoidal commutation.

Encoder polarity, normally low pulse high index "_-_"or normally high pulse low index "-_-", must be set correctly for proper algorithmic phasing or phase correction. Also, the timing of the index pulse, with respect to the state of the A+B pulses, must be selected correctly for proper detection of the index pulse.

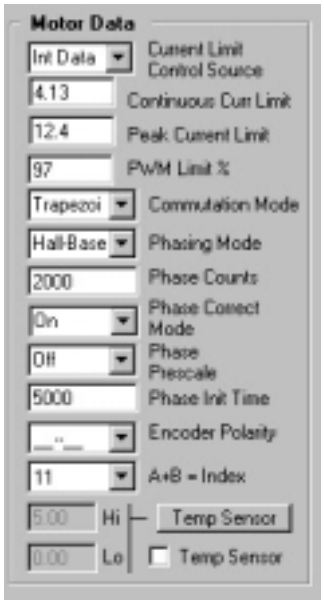


Fig. 11A: Motor data values

First time phasing

If a motor has been previously phased for commutation with a Copley amplifier then the same wiring of the Halls and motor phases will apply. Otherwise use the Auto Phasing routine for proper phasing of a new motor. This screen is located under **Diagnostics>Specail>More>Auto Phase**. See Fig. 11B. Prior to phasing the amplifier must have values set, either from an amplifier file or model calculation. Torque mode with 0% command is good and +-3% command can be used after phasing to test.

Auto phasing

The Auto phasing screen can be used to phase the motor Halls, encoder, and UVW power wires. Check the Auto update box to read the present Hall state. If the motor is rotated through 1 electrical cycle then all 6 Hall states can be viewed, if the motor Halls are phased correctly then the **Hall angle** Green LED will make 1 congruent rotation. Press **Attempt Phasing** to initiate the routine. The default motor command will be 10% of continuous current setting, the phase init time will be in the range of 1 to 10 seconds, and the phase counts settings will be used. If all goes well then the **Output Angle** will track the Hall angle, and any **Hall offset** detected will be indicated.

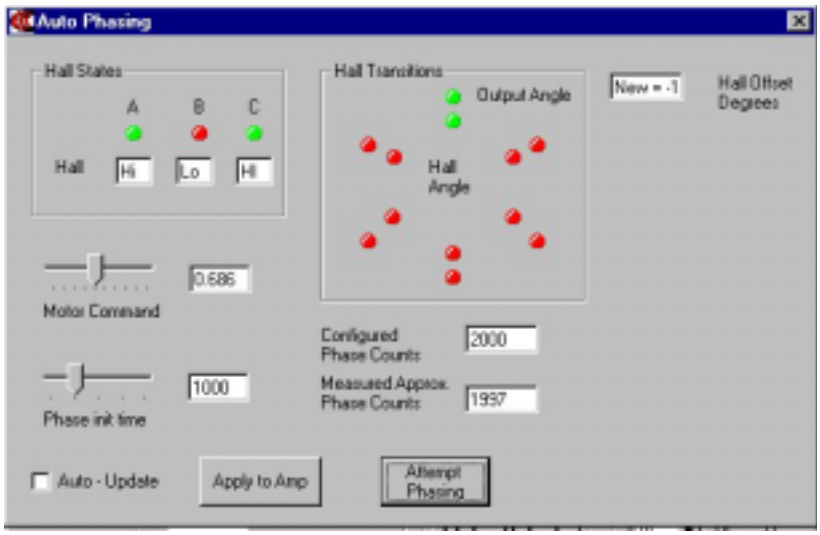


Fig. 11B: Adjustments to initial tuning calculations.

Intuitive Tuning Slides

After the model calculates the initial tuning parameters, the slides can be used to adjust the model parameters, much like a mechanical engineer would understand the system. See Fig 11C. The slides make intuitive tuning adjustments possible with the motor and load connected in a system.

Current Loop Slides

The Bandwidth slide can be used to increase or decrease the current loop response. If proper values of motor inductance and resistance are entered for the calculations then the default current loop response is typically > 1kHz. The Peaking slide can be used to effect the amount of overshoot of the current loop response. Typical peaking is about 5%. The default current loop values calculated by the model are excellent so, it is unnecessary to change them.

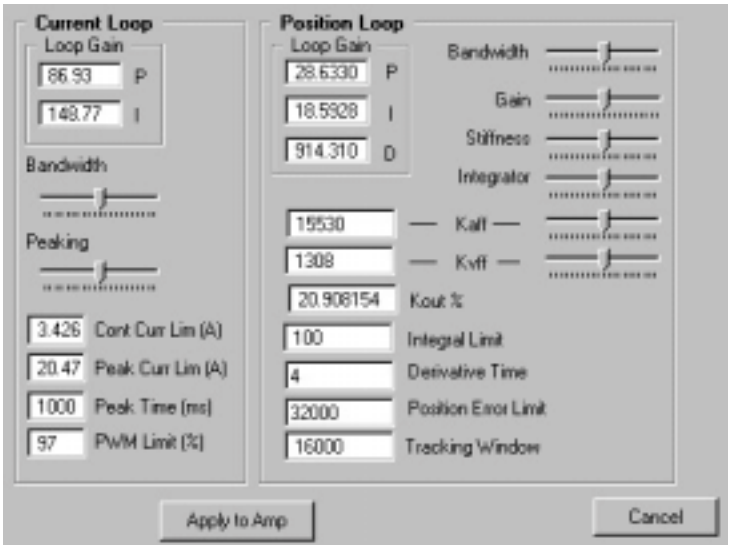


Fig. 11C: Adjustments to initial tuning calculations.

Position Loop Slides

The Bandwidth slide can be used to change the system bandwidth, effecting the PID values, “I” Term and “D” term mostly. The Gain slide changes the overall system gain by effecting the Kout term. The stiffness slide changes the system stiffness by effecting the “P” term. The Kaff slide changes the acceleration feed forward by effecting the Kaff term, this is used to reduce position error during acceleration. The Kvff slide changes the velocity feed forward by effecting the Kvff term, this is used to reduce position error during velocity.

Operating Mode Briefs

At the time of this printing there are several operating modes available, such as position mode, velocity mode, stepper mode, and torque mode. Future releases will make more modes of operation available.

Position mode

By selecting **Pos>Torque**, from the Operating mode pull down list, the drive can be configured for a position loop driving a current loop. The current loop gains and limits apply to the torque loop that operates inside the position loop. With the position loop selected the motion profile and position loop values are applicable.

Velocity mode

The velocity loop operates as a position loop that never reaches the destination position. By selecting **Pos>Torque**, from the Operating mode pull down list and then selecting **velocity** from the profile mode pull down list, the drive can be configured for a velocity loop in a position loop driving a current loop. The current loop gains and limits apply to the torque loop that operates inside the position loop. With the velocity loop selected, some of the motion profile and all of the position loop values are applicable.

By selecting **+/-10V>Pos>Torque**, from the Operating mode pull down list and then selecting **velocity** from the profile mode pull down list, the drive can be configured for a velocity loop, in a position loop, driving a current loop, that uses the external +/-10V reference to command velocity. The current loop gains and limits apply to the torque loop. With the velocity loop selected, some of the motion profile and all of the position loop values are applicable.

Torque mode

By selecting **Torque**, from the Operating mode pull down list, the drive can be configured for a torque (or current) loop. The current loop gains and limits apply to the torque loop. With the torque loop selected the **Command %** and Current loop values are applicable. The motion profile and position loop values are not applicable.

By selecting **+/-10>Torque**, from the Operating mode pull down list, the drive can be configured for a torque (or current) loop that uses the external +/-10V reference to command current. The current loop gains and limits apply to the torque loop. With the +/-10V>torque loop selected the Current loop values are applicable. The command %, motion profile, and position loop values are not applicable.

Digital position mode

By selecting **Pos>Torque**, from the Operating mode pull down list and then selecting **Gear**, from the profile mode pull down list, the drive can be configured for a Digital position loop driving a current loop. The current loop gains and limits apply to the torque loop that operates inside the digital position loop. With the gear profile mode selected, some of the motion profile and all of the position loop values are applicable.

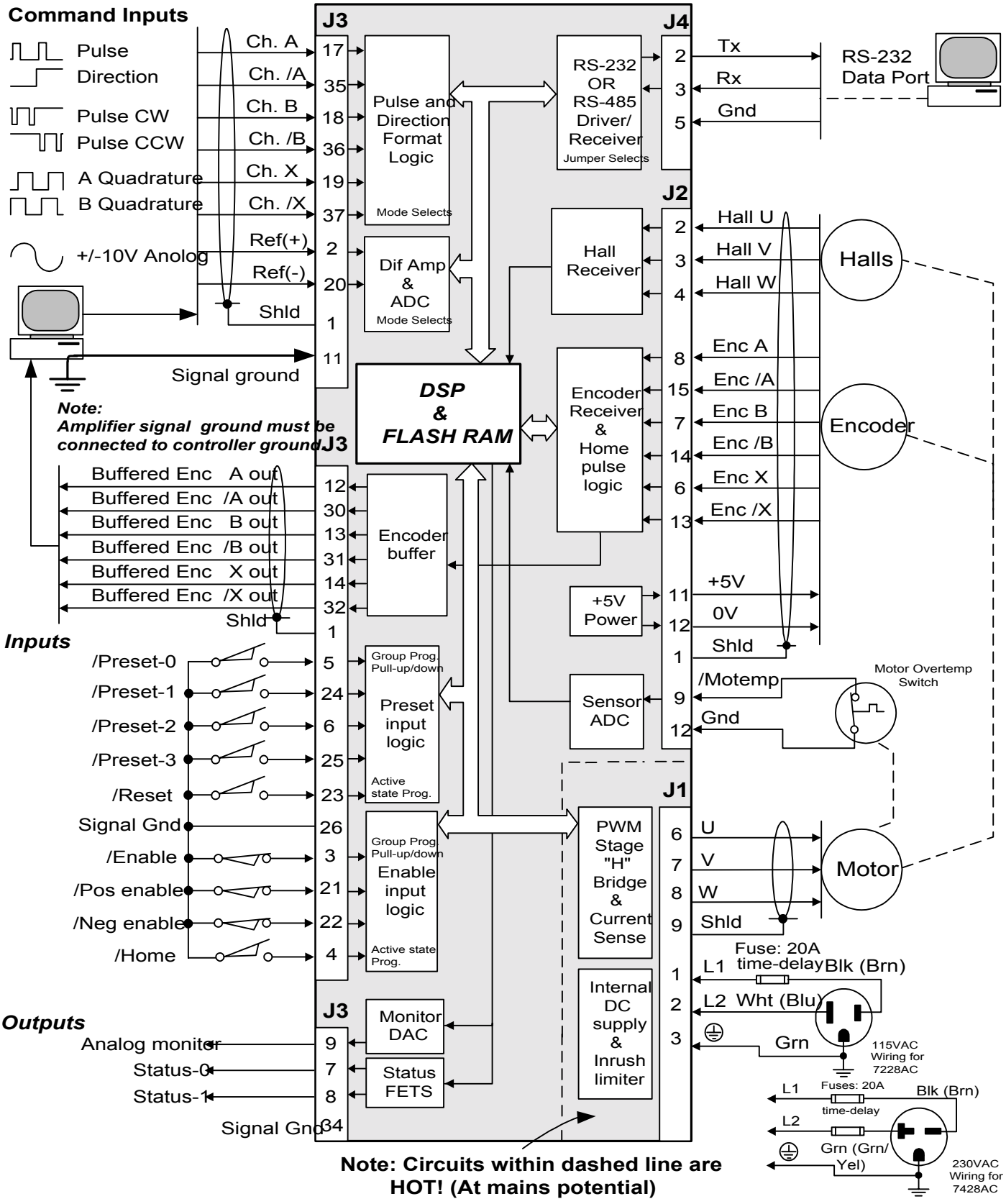
The digital input source can be set to any one of the below listed modes:
A/B Encode, Where quadrature encoder pulses are used as a master encoder to position the motor.
CW / CCW, Where pulses on the clock wise line produce CW rotation and pulses on the counter clockwise line produces CCW rotation.
Pls / Dir, Where stepper pulse and direction are used to position the motor.

Gear Ratio

The gear ratio can be set to scale the number of digital input counts to the number of encoder counts.

Amplifier Connections

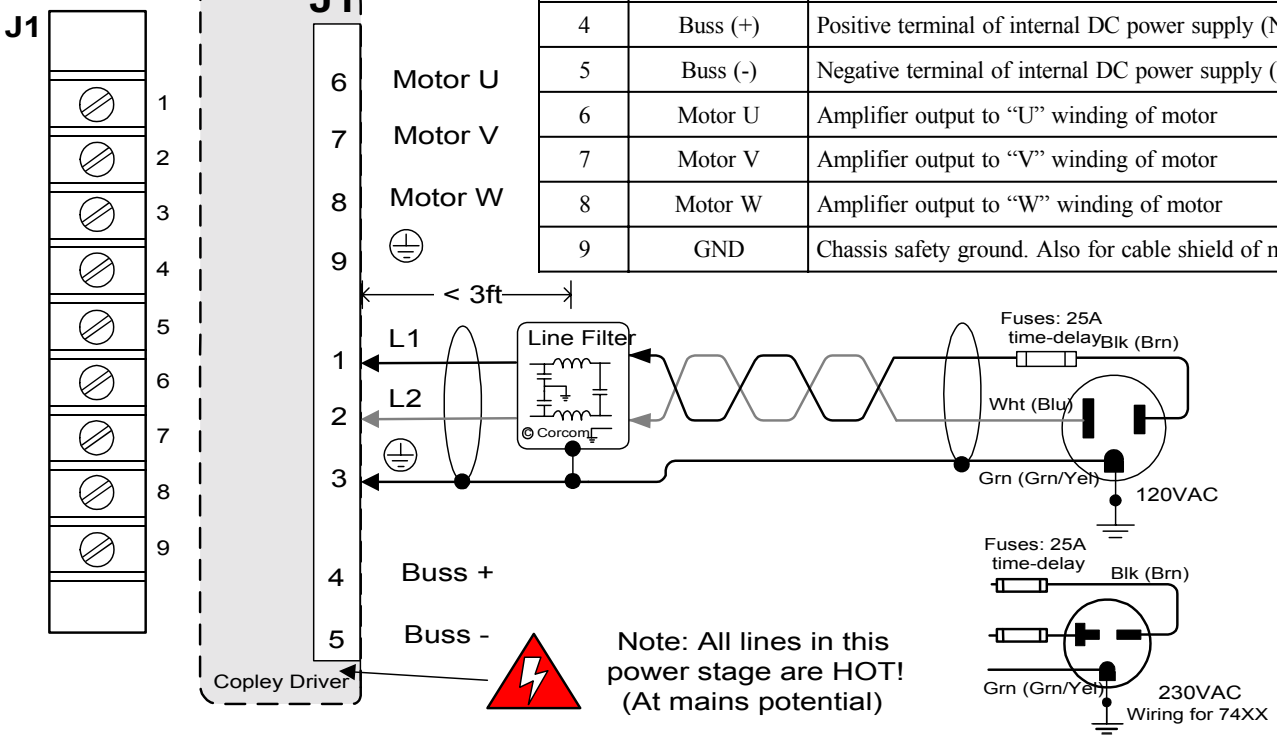
Functional Diagram AC Model



J1 Connections

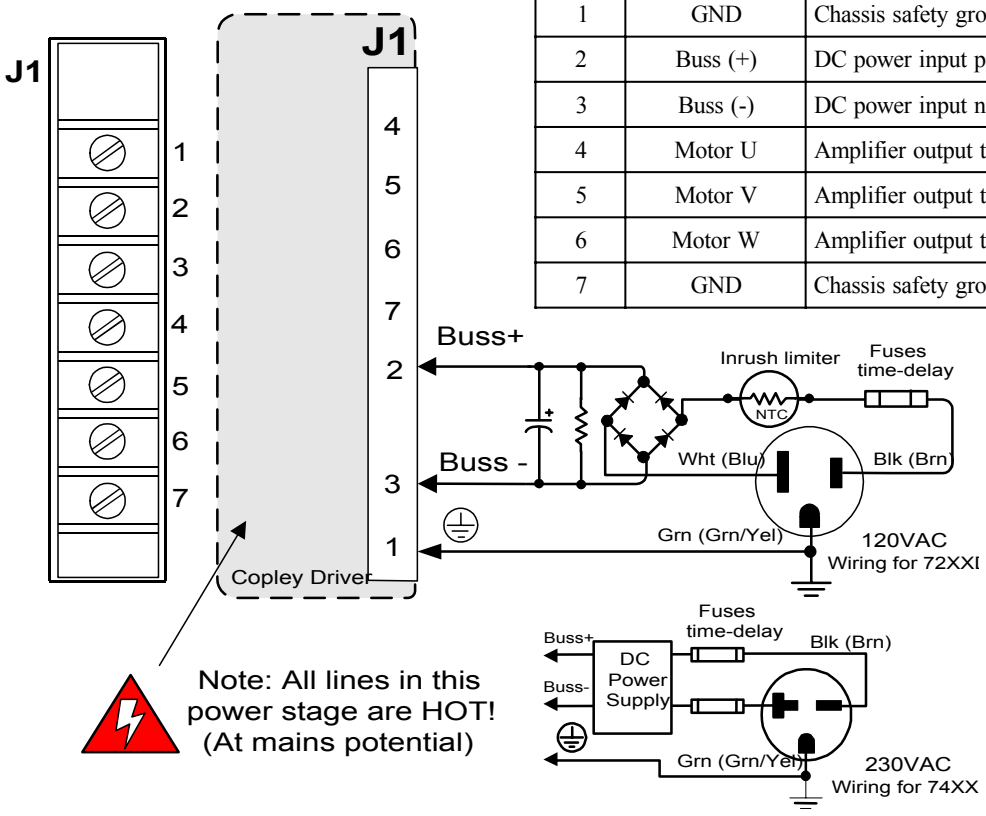
PIN	SIGNAL	Function
1	L1	AC Power Input Hot (black or brown wire from AC mains)
2	L2	AC Power Input Neutral (white or blue wire from AC mains)
3	GND	Chassis safety ground (green or green/yel wire from AC mains)
4	Buss (+)	Positive terminal of internal DC power supply (N.C.)
5	Buss (-)	Negative terminal of internal DC power supply (N.C.)
6	Motor U	Amplifier output to “U” winding of motor
7	Motor V	Amplifier output to “V” winding of motor
8	Motor W	Amplifier output to “W” winding of motor
9	GND	Chassis safety ground. Also for cable shield of motor cable.

AC Model



PIN	SIGNAL	Function
1	GND	Chassis safety ground (green or green/yel wire from AC mains)
2	Buss (+)	DC power input positive terminal from DC power supply
3	Buss (-)	DC power input negative terminal from DC power supply
4	Motor U	Amplifier output to “U” winding of motor
5	Motor V	Amplifier output to “V” winding of motor
6	Motor W	Amplifier output to “W” winding of motor
7	GND	Chassis safety ground. Also for cable shield of motor cable.

DC Model



LED Indicator functions

Color and state of LED indicates amplifier operating conditions:

COLOR	CONDITION	ACTION REQUIRED TO ENABLE
Flashing Green	Ready	Enable amplifier (J3-3) (Note 1)
Green	Normal	None. Normal “RUN” condition.
Red	Power Fault	Bring AC voltage into range.
Flashing Red	Latching Fault	Ground /Reset input, or cycle AC power OFF/ON

Signal Wiring

Signal connections should be made with wire that has a rating to support the signal current. AWG 24 wire will support all motor signals in this series. Additional recommendations for wire insulation are for a voltage rating of 300V and a temperature range of 80°C. To minimize coupling of PWM noise, sensor signal wiring should be multiple-conductor twisted-pair shielded cable. Further more, all cable shields should be case grounded at both ends for compliance with CE emissions limits.

J2 Motor Hall and Encoder Signal Connections

PIN	SIGNAL	Function
1	Safety GND	Chassis ground. Not connected to internal signal ground.
2	Hall U	Digital Hall inputs for “U”
3	Hall V	Digital Hall inputs for “V”
4	Hall W	Digital Hall inputs for “W”
5	Analog Tach	Brush tachometer input
6	Enc Ch. X	Encoder Channel X
7	Enc Ch. B	Encoder Channel B
8	Enc Ch. A	Encoder Channel A
9	Motemp	Motor teperature sensor
10	N.C.	No connection
11	+5V @ 250mA.	DC power for encoders and Halls (Note 1)
12	0V.	Signal ground for +5V and Halls.
13	Enc Ch. /X	Encoder Channel /X
14	Enc Ch. /B	Encoder Channel /B
15	Enc Ch. /A	Encoder Channel /A

Notes:+5VDC @ 250mA connects to J3-15, J3-27 *and* J2-11. Combined not to exceed 250mA.

User & Control Signals Connections

J3 Signal Connections

PIN	SIGNAL	Function	PIN	SIGNAL	Function
1	Safety GND	Chassis/frame ground.			
2	Ref (+)	+/-10V analog command input	20	Ref (-)	+/-10V analog command input
3	/Enable input	Amplifier enable	21	/Pos Enable	Positive direction enable
4	/Home	Home switch input	22	/Neg Enable	Negative direction enable
5	/Preset-0	1 of 4 preset mode select lines	23	/Reset	Amplifier fault reset input
6	/Preset-2	1 of 4 preset mode select lines	24	/Preset-1	1 of 4 preset mode select lines
7	Status-0 Out	Amplifier status output #1	25	/Preset-3	1 of 4 preset mode select lines
8	Status-1 Out	Amplifier status output #2	26	0V Sgnd	Signal Ground
9	Analog Mon	Programmable monitor output	27	+5V Output	+5VDC @ 250mA output
10	Curr Limit	External current-limit input	28	+12V Output	+12VDC @ 25mA output
11	0V Sgnd	Signal Ground	29	-12V Output	-12VDC @ 25mA output
12	Ch. A out	Buffered encoder output Ch A	30	Ch. /A out	Buffered encoder output Ch /A
13	Ch. B out	Buffered encoder output Ch B	31	Ch. /B out	Buffered encoder output Ch /B
14	Ch. X out	Buffered encoder output Ch X	32	Ch. /X out	Buffered encoder output Ch /X
15	+5V Output	+5VDC @ 250mA	33	Ch. A	Encoder input Chan. A
16	N.C.	No connection	34	0V Sig Gnd.	Signal Ground
17	Ch. A in	Encoder input Chan. A	35	Ch. /A in	Encoder input Chan. /A
18	Ch. B in	Encoder input Chan. B	36	Ch. /B in	Encoder input Chan. /B
19	Ch. X in	Encoder input Chan. X	37	Ch. /X in	Encoder input Chan. /X

J4: Communications/Data Connections

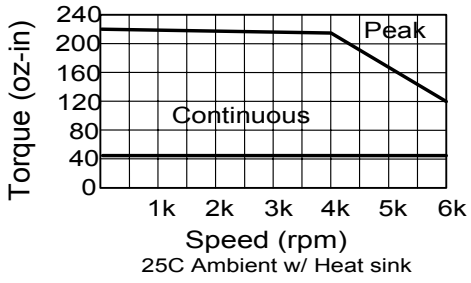
7xx8 models support RS-232 and RS-485. Jumpers on the signal PC board set the configuration for either type of communication protocol. Data connections should be made with wire that has a rating to support the signal current. AWG 24 wire will support all data signals in this series. Ribbon cable is acceptable for short distances and baud rates less than 9600 however, to minimize coupling of PWM noise, data signal wiring should be multiple-conductor twisted-pair shielded cable. The amplifier looks like DCE (Data Communications Equipment) and does not require a “null-modem” cable.

RS-232 Connection

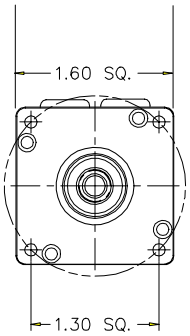
PIN	SIGNAL	Function
1	-	-
2	TxD	RS-232 Serial Data Output (Amp —> Controller)
3	RxD	RS-232 Serial Data Input (Controller —> Amp)
4	-	-
5	Gnd	Ground

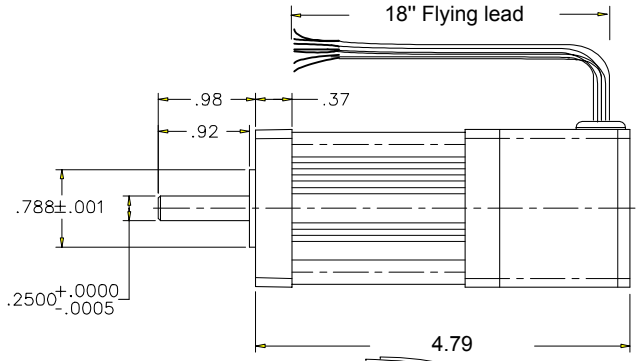
CBL162BE-001 Motor Performa

Buss = 75VDC, Ic = 4A, Ip = 20A



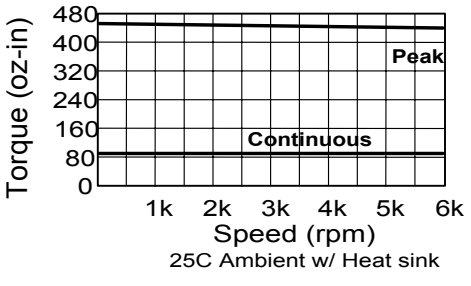
25C Ambient w/ Heat sink



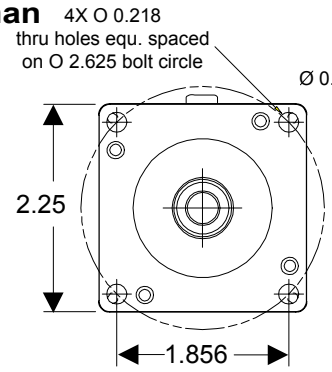


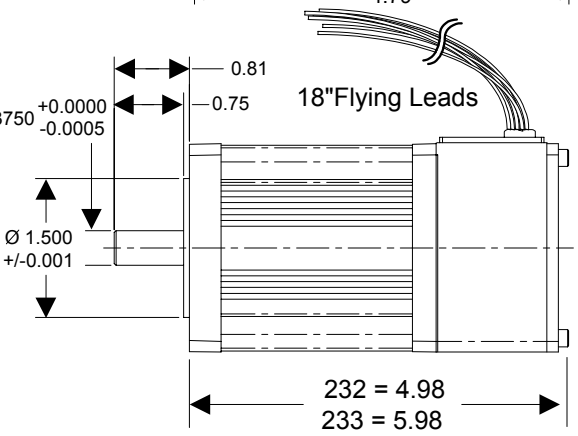
CBL232BE-001 Motor Performan

Buss = 160VDC, Ic = 4.1A, Ip = 20A



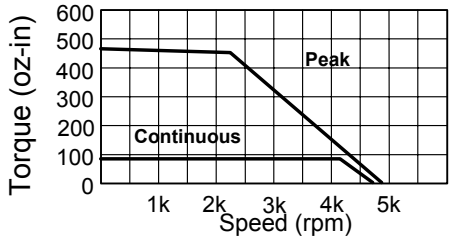
25C Ambient w/ Heat sink



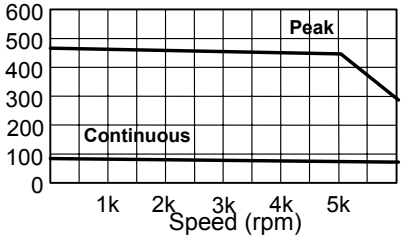


CBL232AE-001 Motor Performance

Buss = 160VDC, Ic = 2.1A, Ip = 10.5A

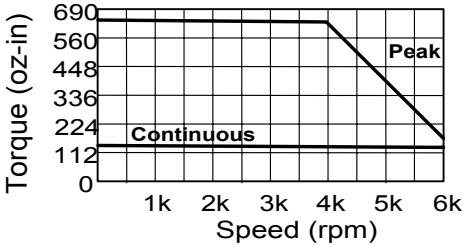


Buss = 250VDC, Ic = 2.1A, Ip = 10.5A



CBL233BE-001 Motor Performa

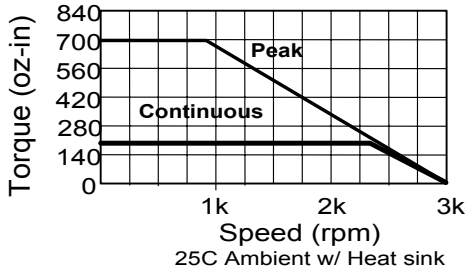
Buss = 160VDC, Ic = 4.1A, Ip = 20A



25C Ambient w/ Heat sink

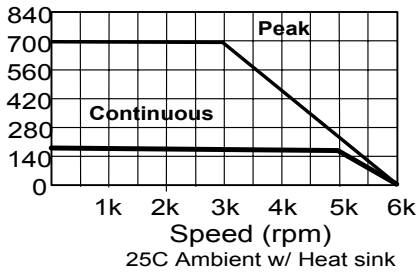
CBL233AE-001 Motor Performance

Buss = 160VDC, Ic = 2.1A, Ip = 10.5A



25C Ambient w/ Heat sink

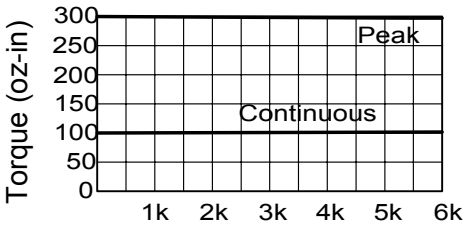
Buss = 250VDC, Ic = 2.1A, Ip = 10.5A



25C Ambient w/ Heat sink

CBL341FE-001 Motor Performar

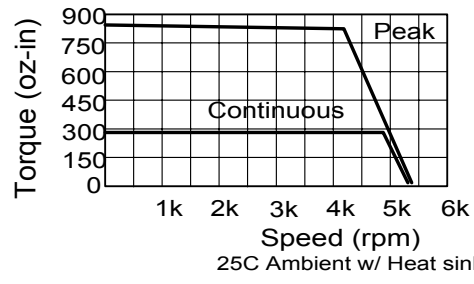
Buss = 160VDC, Ic = 4.1A, Ip = 12.4A



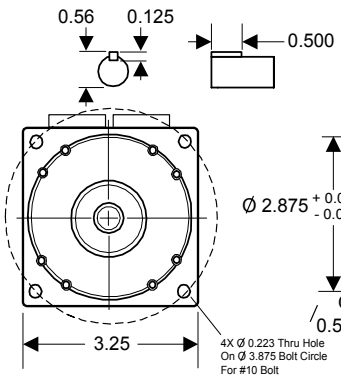
25C Ambient w/ Heat sink

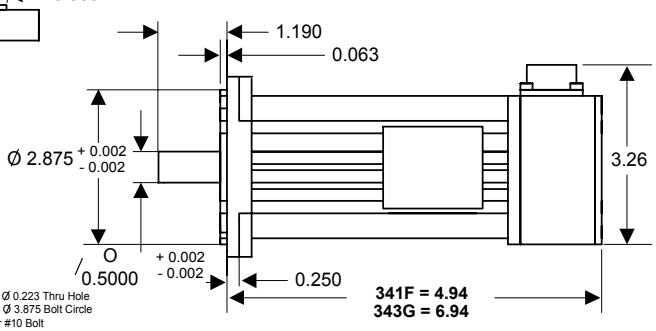
CBL343GE-001 Motor Performan

Buss = 160VDC, Ic = 5.8A, Ip = 15.4A



25C Ambient w/ Heat sink





Amplifier Ordering Guide

Amplifier	Features
7228AC	20A peak, 10A continuouse, from 32~132VAC, 50/60Hz AC mains
7428AC	20A peak, 10A continuouse, from 32~264VAC, 50/60Hz AC mains
7228DC	20A peak, 10A continuouse, from 45~186VDC, (32~132VAC rectified)
7428DC	20A peak, 10A continuouse, from 45~373VDC, (32~264VAC rectified)

Notes:

1. Add "H" to model number to specify heatsink option.
2. Add "F" to model number to specify filter option. Example: 7228ACFH

Value Package Ordering Guide

Motor	Amplifier	Connections	Torque	Speed	NEMA	SHAFT
CBL-162BE-001	7228AC	18" Flying Leads	44 oz-in continuous stall, 220 oz-in peak	6000rpm	Size 16	1/4" round
CBL-232AE-001	7428AC	18" Flying Leads	92 oz-in continuous stall, 460 oz-in peak	4500rpm	Size 23	3/8" round
CBL-232BE-001	7228AC	18" Flying Leads	98 oz-in continuous stall, 477 oz-in peak	6000rpm	Size 23	3/8" round
CBL-233AE-001	7428AC	18" Flying Leads	144 oz-in continuous stall, 700 oz-in peak	2800rpm	Size 23	3/8" round
CBL-233BE-001	7228AC	18" Flying Leads	140 oz-in continuous stall, 685 oz-in peak	6000rpm	Size 23	3/8" round
CBL-341FE-001	7228AC	Millitary Style	102 oz-in continuous stall, 307 oz-in peak	6000rpm	Size 34	1/2" keyway
CBL-343GE-001	7228AC	Millitary Style	288 oz-in continuous stall, 864 oz-in peak	4050rpm	Size 34	1/2" keyway

Notes:

1. Value packages do not include accessories, see development kits for a complete set of all accessories.

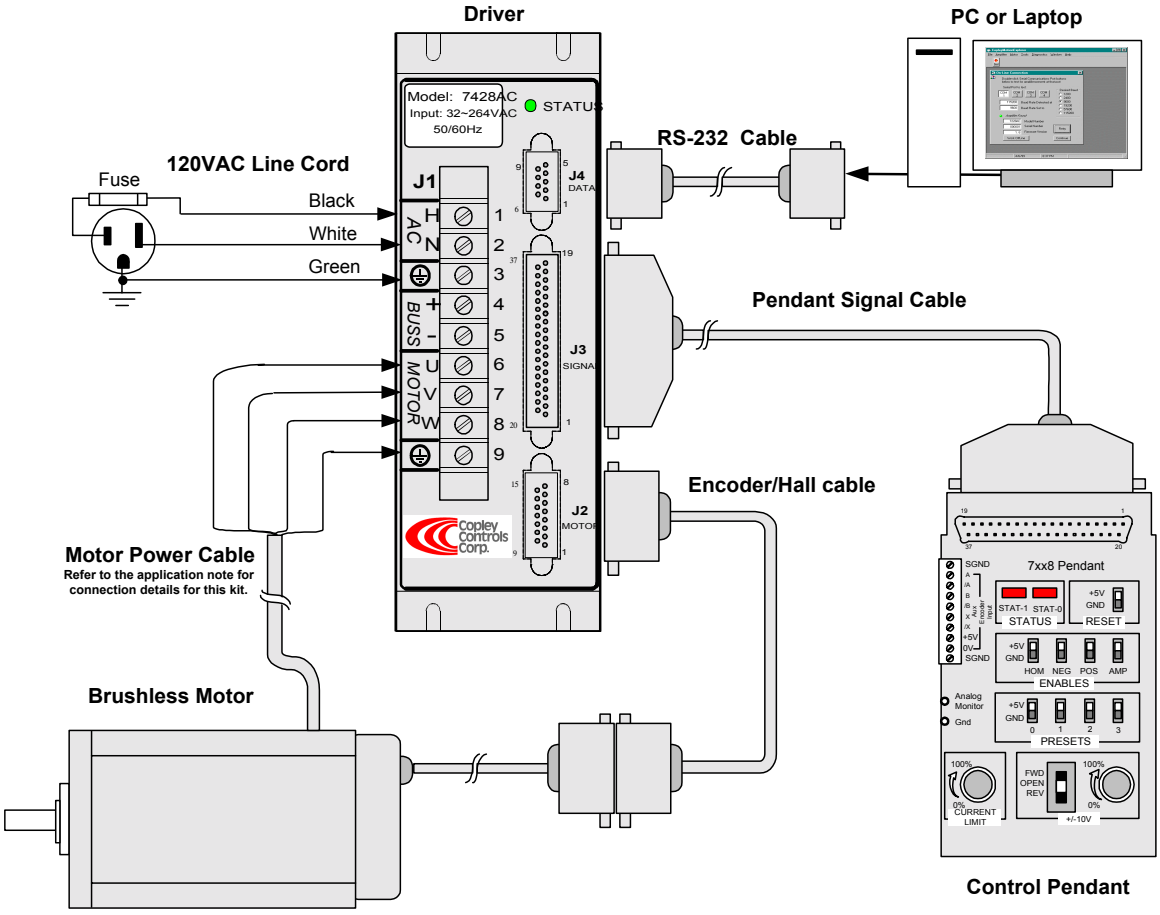
Accessories Ordering Guide

Accessories	Features
Control Pendant	Hand controler with switches, potentiometers, and connections for testing
Software CD	CD rom with Copley Motion Explorer ™ Software
Users Guide	Printed Users Manual for the 7XX8 Digital Amplifier Series

Cables	Connections	Feet	Features
34MS-10	Military Style	10Ft	Twisted shielded cables for motor power and signal
23FL-6	Amp	6ft	Twisted shielded cable for size 23 & 16 motor power
120VAC Line	Plug	6ft	18 AWG USA power cord.
Data Cable	9pin D-Sub	6ft	Twisted shielded cable for RS-232 communication
Pendant Extention	37pin D-Sub	6ft	Twisted shielded cable for control pendant
Motor Signal Extention	15pin D-Sub	6ft	Twisted shielded cable for size 23 & 16 motor signal

Connection Diagram

The diagram below can be used for quick connection of a development kit. If alternative components are used, such as a user supplied motor, consult the users guide for connection details, using a new motor, and first time phasing instructions.



Development Kit Ordering Guide

Kit	Amplifier	Motor	Stall Torque	Peak Torque	Speed	NEMA	SHAFT
Kit-001	7228AC	CBL-162BE-001	44 oz-in	220 oz-in	6000rpm	Size 16	1/4" round
Kit-002	7428AC	CBL-232AE-001	92 oz-in	460 oz-in	4500rpm	Size 23	3/8" round
Kit-003	7228AC	CBL-232BE-001	98 oz-in	477 oz-in	6000rpm	Size 23	3/8" round
Kit-004	7428AC	CBL-233AE-001	144 oz-in	700 oz-in	2800rpm	Size 23	3/8" round
Kit-005	7228AC	CBL-233BE-001	140 oz-in	685 oz-in	6000rpm	Size 23	3/8" round
Kit-006	7228AC	CBL-341FE-001	102 oz-in	307 oz-in	6000rpm	Size 34	1/2" keyway
Kit-007	7228AC	CBL-343GE-001	288 oz-in	864 oz-in	4050rpm	Size 34	1/2" keyway

Notes:

1.Kit Includes: Power cord, Data cable, Motor signal cable, Motor power cable, Connector Kit, Pendant cable, Pendant, Software CD, Users Manual.

2. Size 16 & 23 motors have flying leads with connector. Size 34 motors have military style connectors.